NC STATE UNIVERSITY

scope

FALL 2007

A LOOK INSIDE THE COLLEGE OF PHYSICAL AND MATHEMATICAL SCIENCES

Discoveries that change everything

These two paleontologists' discoveries have revolutionized concepts in their field and beyond.

scope

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On the cover:
Mary Schweitzer and Julia Clarke stand in front of the *Acrocanthosaurus atokensis* at the NC Museum of Natural Sciences. PAMS' partnership with the museum enables Schweitzer to serve as curator of vertebrate paleontology and Clarke as research curator of paleontology at the museum. Photo by Roger Winstead.

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Just for Fun

Discoveries that change everything

PHOTO BY BRADLEY WILSON

Dean Dan Solomon listens to Michael Paesler's remarks at the rededication ceremony for Riddick Hall (see related story, page 16).

Every day, scientists around the world make discoveries that expand human knowledge. Every day, researchers make discoveries that clarify our current understanding, contradict previous findings or introduce something new and unexpected. This results in further questions, study and research as the scientific process continues its diligent approach to determine what we know, what we don't know, and what we need to know.

Every discovery, no matter how large or small, is important. Most are rarely reported outside of scientific journals. But every now and then, discoveries are made that dramatically challenge conventional understandings. These "disruptive" discoveries make headlines not only in the science media, but in the mainstream media as well.

Jim Martin of our Department of Chemistry made such a discovery when he found that liquids have structure, and that they can be engineered with a variety of desired properties. This discovery instantly rendered the traditional definition of "liquid" obsolete and created a new sub-field within materials science, which was reported in the Spring 2003 *Scope*.

John Blondin, Steve Reynolds and Kazimierz Borkowski in our Department of Physics made recent discoveries about supernovae explosions that overturned several long-held beliefs about our universe – beliefs that formed the foundation for many aspects of astrophysics (see story, page 20).

In this issue, you'll read about two faculty members in the Department of Marine, Earth and Atmospheric Sciences whose discoveries have shaken the foundations of paleontology – forever changing how we view the dinosaur/bird relationship, and even how we view the fossilization process itself (see story, page 4).

Research is important—it fuels economic development, enables environmental stewardship, drives development of products and services, improves the human condition and answers our most intriguing questions.

An interesting irony is that neither Julia Clarke nor Mary Schweitzer set out to be paleontologists. They both happened to take paleontology classes that inspired them to change the direction of their academic careers – classic examples of how instructors make a difference by inspiring their students – even those taking a class just for fun.

Discoveries cost money, however. Faculty must spend a significant amount of time preparing research proposals for funding agencies. Competition for funding is fierce, and some fields, such as paleontology, have only small amounts of resources available.

There is a misconception that the state budget and tuition fully funds all of the university's activities and needs. This is far from true, and faculty constantly struggle for additional funding to support the educational and research needs of their students and programs. Equipment, supplies, travel costs, conference fees, graduate student stipends – all are typical expenses covered by research funding.

Research also may be supported by private funds. The chart inside the back cover indicates our goal for such funding in the Achieve! Campaign for NC State.

Our College has a solid record of success when it comes to obtaining competitive funding, and we have experienced a steady growth in support for the last several years. However, the need for resources never goes away, and it is critical to ensuring a quality educational experience for students at all levels.

Research is important – it fuels economic development, enables environmental stewardship, drives development of products and services, improves the human condition and answers our most intriguing questions. It also inspires our students – and we never know which of them will make tomorrow's discoveries, or shake the foundations of their disciplines.

Daniel L. Solomon

Daniel L. Solomon, *Dean*

PHOTO BY SALLY RAMEY

Jack Silverstein

Notables

Robert Bereman (Chemistry professor emeritus)—member, Board of Visitors, Butler University, Indianapolis, Indiana

Bibhuti Bhattacharyya (Statistics faculty)—North Carolina's Order of the Long Leaf Pine, the state's highest civilian honor

Marie Davidian (Statistics faculty)—2007 Janet L. Norwood Award for Outstanding Achievement by a Woman in Statistical Sciences

Alexander Deiters (Chemistry faculty)—Sigma Xi Faculty Research Award; Cottrell Scholar for proposal "A Library Approach to Cellular Light Receptors"

Jacqueline Hughes-Oliver (Statistics faculty)—Fellow, American Statistical Association

Jack Silverstein (Mathematics faculty)—Fellow, Institute of Mathematical Statistics

Daniel Solomon (Dean)—Chapter Award, American Statistical Association, North Carolina Chapter

Bill Swallow (Statistics faculty)—Mu Sigma Rho Statistical Education Award

Douglas Young (Chemistry graduate student)—2007–08 American Chemical Society Student Fellowship, Division of Medicinal Chemistry

Elizabeth Zell (MS '80 Statistics)—Fellow, American Statistical Association

Ji Zhang (PhD '90 Statistics)—Fellow, American Statistical Association □

Bryant to lead research center

Robert L. Bryant has been named to a five-year term as director of the Mathematical Sciences Research Institute (MSRI), a major international center based in Berkeley, Cal. Simultaneously, he has been appointed as a tenured professor in the Department of Mathematics at the University of California, Berkeley.

MSRI is one of the world's premier centers for research in the mathematical sciences, and has been advancing mathematical research through workshops and conferences since its founding as an independent institute in 1982. More than 1,700 mathematical scientists visit MSRI each year for stays of up to one academic year. The institute is funded primarily by the National Science Foundation with additional support from other government agencies, private foundations, academic and corporate sponsors, and individual donors.

Bryant received his BS in mathematics from NC State in 1974 and his PhD in mathematics from the University of North Carolina in Chapel Hill in 1979. He received the 2004 PAMS Distinguished Alumnus Award, and has provided support for mathematics students for many years through the John W. Cell Scholarship and the Fund for Excellence.

He started his career at Rice University as an assistant professor in 1979 and was later named the Noah Harding Professor of Mathematics. In 1988, he came to Duke University as the J. M. Kreps Professor of Mathematics. His research focuses on nonlinear partial differential equations and differential geometry.

"Robert has excelled in every area in which academic achievement can be measured," said PAMS Dean Dan Solomon. "We are very proud that he has been selected to lead one of the world's most prominent mathematics research organizations."

Bryant visited MSRI in 2001 as the Clay Mathematics Visiting Professor while on sabbatical. He returned to MSRI in 2003 as co-organizer of the institute's research program in Differential Geometry. He also served as a member of MSRI's board of trustees in 1999–2004 and as chair in 2001–2004.

He was appointed by President George W. Bush to the Board of the Vietnam Education Foundation (2002–05). In 2002, Bryant was elected to the American Academy of Arts and Sciences. Earlier this year, he was elected a member of the National Academy of Sciences. He also serves as vice president of the American Mathematical Society, and director of the Institute for Advanced Study/Park City Mathematics Institute.

According to his MSRI predecessor, David Eisenbud, Bryant is a superb researcher, internationally renowned in the mathematical community, one whose scientific interests and knowledge are very broad.

MSRI is one of the world's premier centers for research in the mathematical sciences.

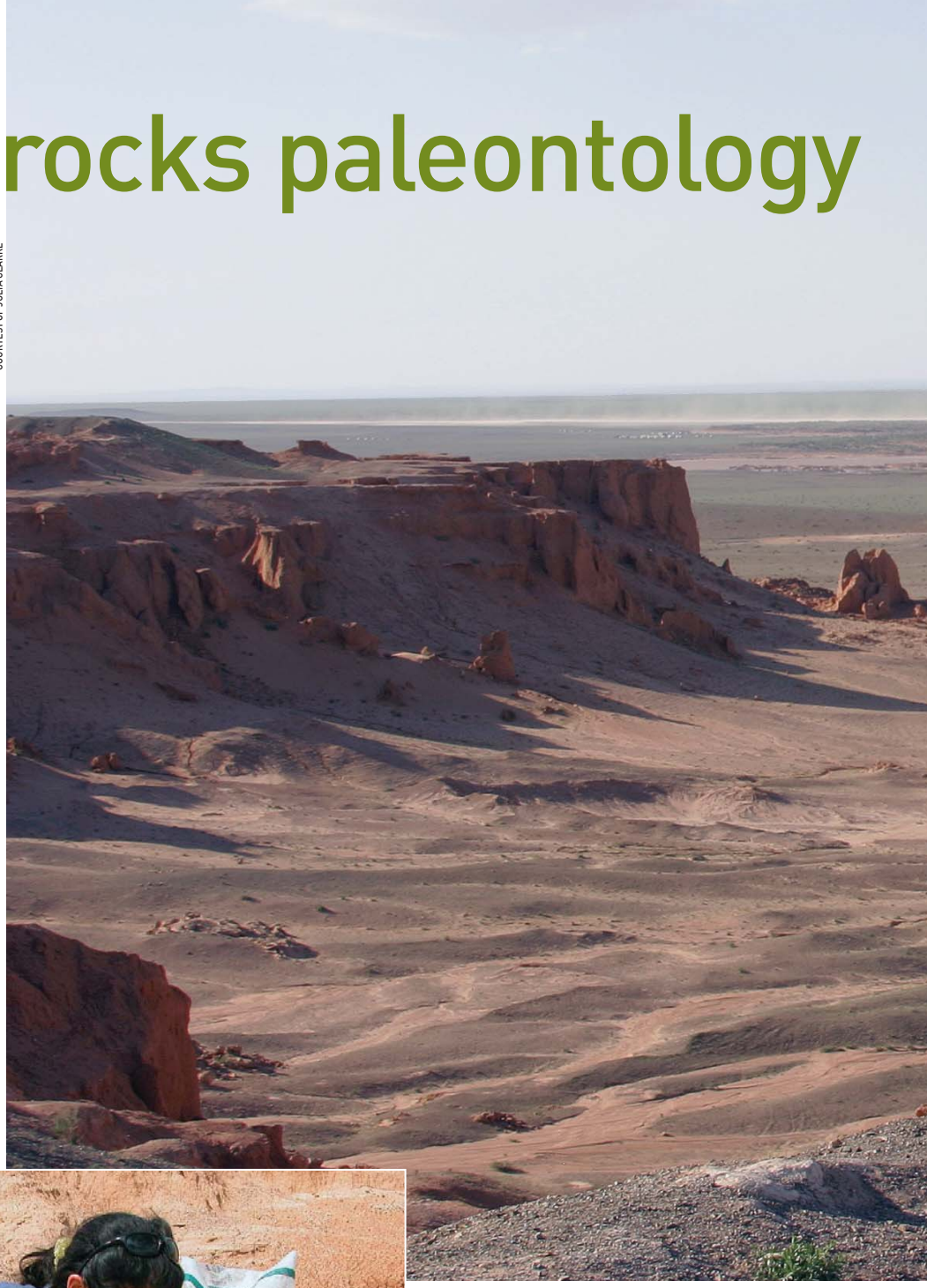
"He is loved as a lecturer and teacher because he thinks so clearly, and cares so visibly and effectively about his audiences and students. He possesses a rare quality of selflessness," said Eisenbud. "I believe that these characteristics, combined with his organizational skill and love of culture will make him a great director." □

PHOTO BY SALLY RAMEY

Robert Bryant

NC State rocks paleontology

NC State's paleontology program consists of only two faculty members – small compared to most other programs. However, within the past few years, these researchers have received worldwide attention for discoveries that have captured the public's imagination and defied long-held scientific assumptions within their field and beyond.



COURTESY OF JULIA CLARKE

Mary Higby Schweitzer's 2005 amazing discovery of soft tissue inside the thigh bone of a 68-million-year-old *Tyrannosaurus Rex* not only led to endless speculation as to whether or not "Jurassic Park" may be within reach, it also revealed how little is really known about fossilization.

COURTESY OF JULIA CLARKE

Julia Clarke unearths the fossil of a tiny dinosaur in Mongolia. Its white bones can be seen just beneath her elbow's shadow.

And while it is now generally accepted that living birds are one group of surviving dinosaurs, Julia Clarke's research has shed new light on the complex transitions linked to the origin of flight in dinosaurs and how there are so many diverse groups of birds today.

But neither scientist set out to shake up the paleontological status quo. In fact, neither set out to be in paleontology at all – until they both just happened to take a class that inspired them, connected them to paleontologists who later became their mentors, and changed the course of their careers.

Julia Clarke overlooks the Flaming Cliffs in the Gobi Desert of Mongolia.

Clarke: So many choices

While growing up in the San Francisco Bay area, Clarke was always interested in science … and literature, language, history, philosophy, culture, archaeology … the list goes on. She loved stories about explorers and adventurers, and she enjoyed finding things like shells or rocks. She volunteered at the California Academy of Sciences and browsed through the museum's many collections drawers, marveling over fossils millions of years old.

Clarke attended Brown University, where her broad interests meant that she considered several areas of study and careers, from geology to literature and philosophy of science. She even considered science journalism. She chose a dual degree in geo-biology and comparative literature and graduated in 1995.

"I didn't know exactly what I wanted to do, but I wanted to be prepared to do it," she said. "A science degree provides a good base in critical thinking, and the comparative literature program required that I become fluent in a foreign language, which I felt was important to whatever I decided to do."

A passionate student, Clarke received a number of fellowships that allowed her to do research and curricular development. She won a coveted Fulbright Fellowship for a research project she designed on scientific travel writing and nationalism in 19th century Argentina.

Before leaving for Argentina, she took a geology seminar on events at the "K/T Boundary," the geologic boundary between the Cretaceous and Tertiary period and the point at which non-avian dinosaurs became extinct. She was fascinated and found an internship with Yale University paleontologist Jacque Gauthier. Yale is a center for research into the relationship of dinosaurs to living birds, and Gauthier is a key figure in that area.

The seminar intrigued Clarke, and Gauthier

Medical gloves at a dinosaur dig? Mary Schweitzer's research has changed the way fossils are handled in the field. If a fossil is in an environment suitable for preservation of soft tissue, care must be taken to avoid contamination.

COURTESY OF MARY SCHWEITZER

encouraged her to enter graduate school in paleontology. After field experience in Patagonia, Argentina, with another fossil bird specialist, Clarke was hooked. Paleontology nourished her diverse interests.

"It allows you to travel extensively, work with scientists from very different cultural backgrounds, and think about interesting questions not only from science but history and philosophy," she said.

She earned a doctorate from Yale's Department of Geology and Geophysics in 2002, after which she spent two years as a Frick Postdoctoral Fellow at the American Museum of Natural History in New York.

Schweitzer: A third career

Inspired by books given to her by her brother, Schweitzer decided when she was five that she wanted to be a paleontologist when she grew up.

Of course, childhood dreams rarely come true. Schweitzer left her hometown of Helena, Montana, to attend Utah State University. After receiving a degree in speech therapy in 1977, she moved home, got married and raised three children. Later, she decided to become a high school science teacher, so she earned a teaching certificate from Montana State University in Bozeman.

She finished school in December of 1988, but wouldn't graduate until spring. During this time, and just for fun, she took a class under famed paleontologist Jack Horner, the inspiration for the "Dr. Alan Grant" character in Michael Crichton's book *Jurassic Park*, and advisor to the *Jurassic Park* films.

The class reawakened her interest in dinosaurs, and afterward, she volunteered at the Museum of the Rockies, where Horner is curator of paleontology. While working as a substitute teacher, she immersed herself in reading about dinosaurs and using junk fossils to teach herself about microscopic bone characteristics. When Horner could no longer address her questions, he advised her to go to graduate school and find the answers herself.

She took his advice, and almost immediately, she found structures that appeared to be red blood cells in a thin section of dinosaur bone. When Horner saw the structures, he asked her if she thought they were preserved dinosaur blood cells.

"No," she said. After all, according to conventional wisdom, this was impossible.

Known for challenging convention, Horner said, "Then prove that they're not."

"I had just submitted the proposal for my master's thesis the day before," she said. "And then suddenly, the focus of my research changed, and my degree went from being a master's to a PhD."

How *do* you prove that tiny red discs are ancient blood cells, and not a contaminant such as a fungus? This question had never been asked. In fact, no one had ever looked at fossilized structures at this scale. Schweitzer had

"We tend to think of penguins as being cold-adapted species, but the new fossils date back to one of the warmest periods in the last 65 million years of Earth's history. The evidence indicates that penguins reached equatorial regions more than 30 million years before previous estimates."

Julia Clarke

to develop, test and perfect research methods never before attempted. The work kept her busy throughout her graduate school years, and for several years after receiving her PhD in 1995.

New ideas take flight

Clarke came to NC State's Department of Marine, Earth and Atmospheric Sciences in 2004 as an assistant professor. She also is a research associate for the American Museum of Natural History, and a research curator for the NC Museum of Natural Sciences.

Within only five years of earning her doctorate, Clarke has published an impressive number of major papers.

Soon after joining NC State, Clarke announced the discovery of 42 million-year-old penguin fossils from southern-most South America, doubling the previous penguin fossil record on that continent. Her findings also provided support for the idea that penguins may have first lived in warm climates and only later adapted to cold ones.

A year later, in 2005, she published a paper in the journal *Nature* about a 65 million-year-old relative of ducks and chickens. Until this discovery, scientists had debated whether ancestors of living bird groups existed that long ago or came on the scene only after non-avian dinosaurs became extinct. This find settled that argument and represented the first proof that a relative of modern birds lived alongside non-avian dinosaurs. It also proved that these birds survived the mass extinction event that killed off the dinosaurs.

In June 2007, *Proceedings of the National Academy of Sciences* published Clarke's discovery of two new species of extinct equatorial penguins – one of which stood five feet tall and had a fearsome, never-before seen, spear-like beak.

This giant penguin lived about 36 million years ago. The other species lived about 42 million years ago, was about two and one-half to three feet tall, and represents a very early stage of penguin evolutionary history. Both lived on the southern coast of Peru, and are among the most complete early penguin fossils ever found.

Penguins were thought to have evolved in the high latitudes of Antarctica and New Zealand, moving closer to the equator about 10 million years ago, long after significant global cooling that occurred about 34 million years ago.

"We tend to think of penguins as being cold-adapted species," Clarke said. "But the new fossils date back to one of the warmest periods in the last 65 million years of Earth's history. The evidence indicates that penguins reached equatorial regions more than 30 million years before previous estimates."

Clarke cautioned against assuming that because ancient penguins thrived in warm climates, today's penguins aren't endangered by global warming. Today's climate change is happening on a distinctly shorter time scale and involves only living penguin species that may be cold-adapted.

Most recently, Clarke announced yet another surprise about dinosaur size, which was published in a September 2007 edition of *Science*.

Paleontologists have long theorized that miniaturization was one of the last stages in the long series of changes required for dinosaurs to make the evolutionary "leap" to take flight and become birds. But new evidence from a tiny Mongolian dinosaur shatters the theory.

"This specimen shows that dinosaurs evolved small size earlier than we previously thought," Clarke said. "And even more interesting is that in a couple of the lineages most closely related to birds, dinosaurs didn't stay small – they got much larger. So we now see some competing trends within very closely related groups over the same Cretaceous time interval."

If miniaturization of dinosaurs occurred well before the origin of flight, then this raises other questions about the ways that paleontologists have traditionally explained trends in the early history of birds.

"We thought dinosaurs got smaller, grew faster and flew," Clarke said. "Now that we see small size occurring well before many other innovations in locomotion and growth strategy, it forces us to question previous assumptions about the acquisition of traits seen in living birds."

Blood from a stone

Scientists have long believed that when a creature died and became fossilized, soft tissues rotted away and bones were transformed into rock through a gradual replacement of all organic material by minerals, forming a stone copy of the original. This belief was so firmly rooted that no one had ever bothered to look very closely at the process, or the fossils themselves.

Schweitzer's work on small features and structures within fossils revealed that mineralization can copy even the tiniest structures. Much can be learned about dinosaurs from the tiny details hidden within their bones. But because she was studying fossils at a scale, and with methods never before tried, she found something amazing.

When forced to break a *T. rex* thighbone so it could be removed from an eastern Montana

COURTESY OF MARY SCHWEITZER

Mary Schweitzer's tent stands beneath eastern Montana's "big sky."

dig site, Horner found some odd-looking fossilized tissue within the hollow of the bone. Still collaborating with Schweitzer on research, he sent some to her. She knew instantly that it was medullary bone, a blood-rich tissue birds develop to pull calcium from the bones to use in forming eggshells.

"We have a girl!" said Schweitzer, "And she's pregnant!"

If she was right, this was the first time a *T. rex*'s gender had been determined. It also more closely tied *T. rex* to birds. She set out to check her theory, looking at details such as microscopic tissue structure and vascular patterns and comparing them to emus and ostriches, living birds with ancient characteristics.

Along the way, Schweitzer soaked a sample from the *T. rex* in a light acid bath for a few hours, which would dissolve away a small amount of mineral so she could better see underlying structures. But instead of leaving behind a partly-dissolved piece of rock, the acid revealed a mass of red, squishy, stretchy tissue. Under the microscope, flexible, hollow blood vessels were visible with what appeared to be blood cells inside them.

COURTESY OF JULIA CLARKE

Graduate student Drew Eddy excavates a fossil near Ghost Ranch in New Mexico.

The announcement in 2005 of the discovery of soft dinosaur tissue shocked the world. The work was published in *Science*, and it became what is believed to be the biggest international news story in NC State's history.

Despite the whirlwind of attention, Schweitzer focused on the more important question at hand. What was the soft tissue made of? Was it some sort of strange copy of the original tissue produced by a never-before-studied aspect of fossilization, or could it be real dinosaur protein? And if so, how was it possible?

... the material from the *T. rex* was collagen—original dinosaur tissue, remarkably preserved after 68 million years.

Schweitzer announced in 2006 that she had successfully duplicated her results in several other fossils of various ages, proving that the *T. rex* discovery was no fluke. The work also indicated that fossilization under specific conditions seemed to produce favorable conditions for soft tissue preservation inside large bones.

Then in 2007, Schweitzer and colleagues at Harvard published joint papers in *Science*, confirming the unbelievable. The Harvard team successfully sequenced dinosaur protein Schweitzer extracted from the tissue, identifying the amino acids and confirming that the material from the *T. rex* was collagen – original dinosaur tissue, remarkably preserved after 68 million years.

Further, when compared to a database containing existing sequences from modern species, they found that the *T. rex* sequence had similarities to those of chicken, frog and newt, but more so to chicken.

These latest results were also published in *Science*, and again made headlines around the world, including the predictable, "*T. rex* just a big chicken."

Humor aside, Schweitzer's discoveries have scientists asking questions.

"From a paleo standpoint, sequence data confirms the preservation of these tissues," Schweitzer said. "This will help us learn more about dinosaurs' evolutionary relationships, how preservation happens, and how molecules degrade over time, which could also have some important medical implications for treating disease."

Schweitzer also hopes that the techniques she has developed over the years will be useful in the search for evidence of life on other planets, including our neighbor, Mars.

Inspiring the next generation

Schweitzer and Clarke have made their marks on modern paleontology, and the program is poised to continue this pattern with the work of its majors and graduate students.

They take their responsibilities to students very seriously. Schweitzer will even kick her department head out of her office if a student comes by to talk with her.

"Mary is a great advisor," said graduate student Jeremy Green. "And not just about school and research, but about life."

Clarke said she enjoys the challenges of getting undergraduates to think about science as a career, and mentoring graduate students.

"The reason I'm in academia is that I love the research, and I want to create opportunities for students to discover how incredibly cool it is. I want to help inspire and train the next generation of systematic paleontologists," she said.

Under their mentorship, six graduate students and several undergraduate students are pursuing a wide variety of projects. From the ancient origins of seabirds to the diets of dicynodonts–ancient creatures sharing common ancestry with today's mammals–it seems likely that another major discovery is right around the corner (see related story, next page). □

Meet the next generation in paleontology

PHOTO BY ROGER WINSTEAD

Pictured above are (front row) Liz Johnson, Mary Schweitzer, Julia Clarke, Dan Ksepka, (back row) Tim Cleland, Clint Boyd, Adam Smith, Drew Eddy, Jeremy Green and Tim Collier.

Liz Johnson is in her first year as a paleontology graduate student at NC State. An Idaho native, she received her BS at Montana State University, where she enjoyed four field research seasons with Museum of the Rockies.

"Surprisingly, no one knows how fossils form," she said. "I want to figure out exactly how fossils form in a chemistry sense."

Johnson said she came to NC State to work with Mary Schweitzer.

"Her findings have turned paleontology upside down. Protein sequencing from a dinosaur shouldn't be possible, yet it is," she said. "Hopefully, my research can add to how such remarkable preservation occurs."

Many factors may impact the fossilization process – sediment type, ground water interactions, even the role of decaying flesh.

"I plan to test these variables by putting modern bone in simulated environments, then see if there are any chemical similarities or differences between modern and fossil bone," said Johnson.

Tim Cleland, a graduate student in chemistry, also pursues the chemical angle.

"I'm doing chemistry on the concretion in Willo to determine if it is a heart, a stone concretion, or some combination of both," he said. "I will look for organically derived materials, and examine samples under a microscope to look for original cell structure." Willo, a *Thescelosaurus*, is located at the NC Museum of Natural Sciences. Professor emeritus Dale Russell generated worldwide controversy in 2000 when he announced that Willo contained a mammal-like fossilized heart.

Like Julia Clarke, graduate student Adam Smith is interested in ancient birds, specifically alcids – seabirds that catch fish by using their wings to fly underwater.

"I am revising the alcid family tree, both current and extinct," he said. "Once I do that, I'll be able to connect changes in these species to major climatic events in the past. This may assist in our interpretations of present-day shifts in sea-bird population ranges due to current global warming trends."

Like his fellow paleontology students, Smith conducts research on collections at the NC Museum of Natural Sciences. Another paleontology student, Drew Eddy, is studying the museum's largest dinosaur fossil, the *Acrocanthosaurus atokensis*, shown in the photo above.

"This specimen has a nearly complete skull. Although its exterior has been studied, its interior has not," he said. His study of the braincase, palate and other features will help determine if the "Acro" was related to Allosaurus, which had a somewhat global distribution, or to other similar dinosaurs found in Africa and South America.

The paleontology research group is small, enthusiastic and close-knit.

"Although the paleo program at NC State is still in its infancy, I feel very privileged to be a part of it," said Smith. "We benefit from the fact that Dr. Schweitzer and Dr. Clarke represent two extremes of the spectrum of sub-disciplines in our field. I feel that we get a broader view of issues in our field because of their range than paleo students at many other schools." □

Brandy Benedict's story made the front page.

PHOTO BY SALLY RAMEY

Mathematics student explores science writing career

Science writing is considered one of the most challenging areas within journalism, and a career path not often considered by either journalism or science majors – two groups who take few classes in each other's disciplines. However, a summer fellowship inspired a PAMS student to pursue this field.

As part of its mission to "increase public understanding of science," the American Association for the Advancement of Science (AAAS) sponsors an annual fellowship in mass media. For 10 weeks each summer, 18 rookie science writers spend time at radio stations and newspapers across the country, exploring and refining a possible future trade.

The fellowships are highly competitive, with more than 150 applicants. Two of the 2007 fellowships were awarded to NC State graduate students, one of whom was Brandy Benedict, who is studying applied mathematics.

"I've always liked math and science, but was never sure what I wanted to do – I thought maybe I'd do research in industry," she said. "But the graduate program required a lot of writing, and I found that I really loved it. And when two different people mentioned the AAAS program to me at two different points in my graduate career, I finally decided to try it."

Benedict worked at the Milwaukee *Journal-Sentinel* newspaper in Wisconsin. She produced 10 stories for the paper during the summer, including a Sudoku math game story that graced the front page.

"That was pretty special – math stories are rare, especially a math story that makes it to page 1A!" she said.

Benedict added, "It was a fantastic way to explore an interest. And although I was an intern, I didn't feel like one. I got the opportunity to be a real reporter, to do real stories and to get some great experience." □

Masters of analytics program introduced

PAMS and the Department of Statistics are partners in a new master's program in the emerging field of analytics. Elements of the curriculum were developed in collaboration with SAS.

The term "analytics" covers a broad spectrum of activities, which includes data collection and integration, statistical methods, and complex processes for enterprise-wide decision making. As the use of analytics becomes more widespread, there is mounting demand for professionals with strong quantitative skills coupled with an understanding of how the techniques are applied to a variety of critical tasks facing decision-makers.

The master of science in analytics (MSA) is an intensive 10-month degree designed to give students a thorough understanding of the tools, methods, applications and practice of advanced analytics. It is both focused and practical in its orientation, with the goal to provide an education that is directly applicable to positions in industry.

The MSA is an integrated, interdisciplinary curriculum consisting of courses developed exclusively for the program. Topics of study include data mining, forecasting, optimization, text analytics, databases, data visualization, data privacy and security, financial analytics, and customer analytics, among other areas. Students gain hands-on experience with the same complex tools used in industry today. Team projects are based on real analytical problems facing organizations.

Dave Dickey, professor of statistics, is one of the PAMS faculty members involved with the program. His modules on time series and data mining give hands-on experience with modern statistical tools, providing students with skills that will catch the eyes of today's employers.

As the use of analytics becomes more widespread, there is mounting demand for professionals with strong quantitative skills coupled with an understanding of how the techniques are applied to a variety of critical tasks facing decision-makers.

"It has been an absolute pleasure to work with the fine first-year MSA class," he said. "This empowering program is not for the faint of heart. Its tight schedule and demands require dedication, and these students have dedication and enthusiasm in abundance. We are all quite proud of them."

The degree program has attracted strong interest from the business community, which sees a growing shortage of professionals who possess the analytical skills needed to address the challenges of a data-rich world. Last year, SAS made a major gift to NC State to facilitate the development of new courses. Since then, SAS has played a collaborative role in helping NC State develop the program. An interdisciplinary group of 45 faculty members shaped the curriculum.

The program is managed by the university's new Institute for Advanced Analytics, located on Centennial Campus and led by Professor Michael Rappa. □

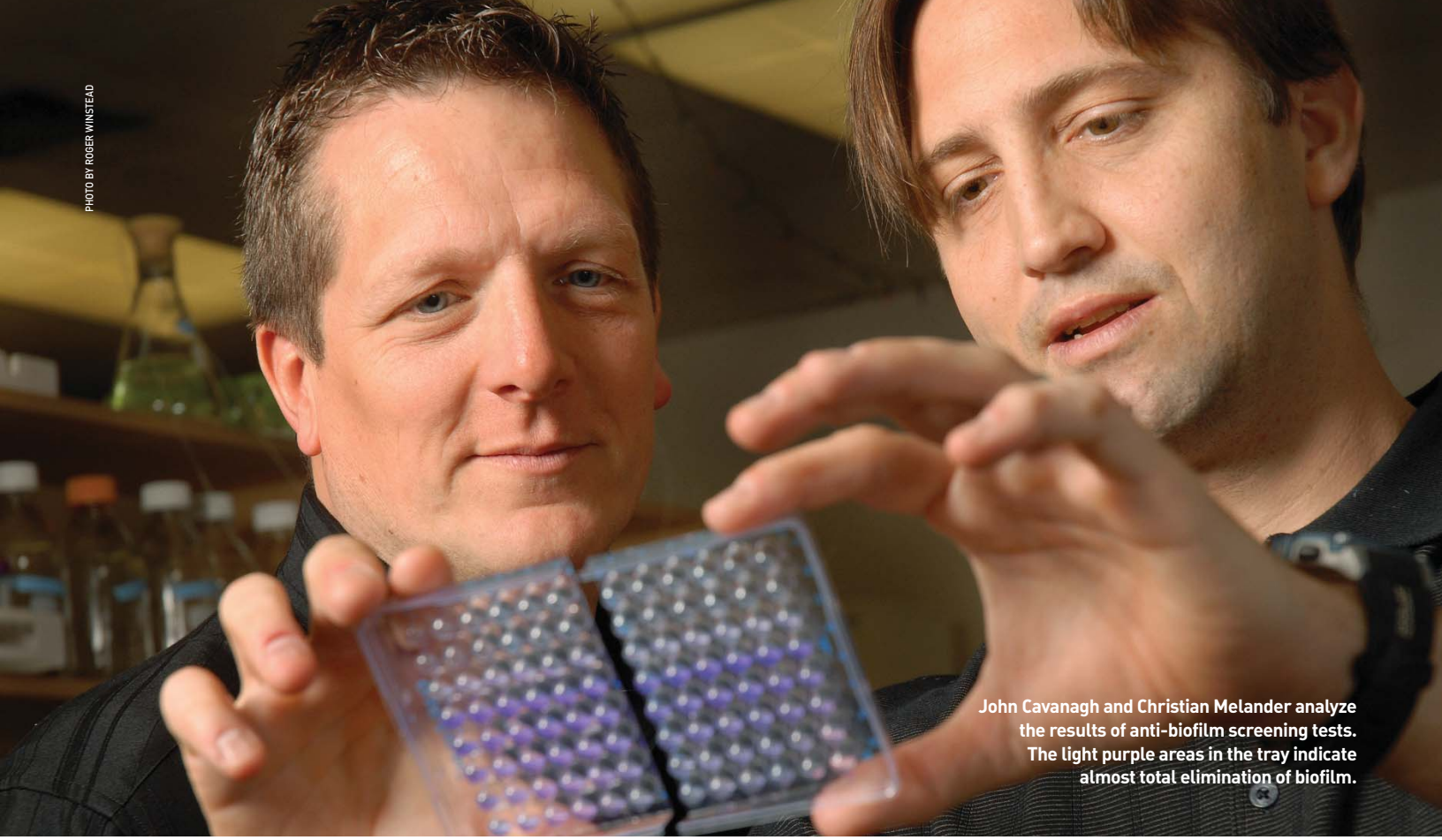


PHOTO BY ROGER WINSTEAD

John Cavanagh and Christian Melander analyze the results of anti-biofilm screening tests. The light purple areas in the tray indicate almost total elimination of biofilm.

Fishing for seafood safety

If you have been avoiding shellfish since having a brutal attack of gastroenteritis after eating oysters on the halfshell, you may have experienced an attack of a "superbug."

The bacterium *Vibrio parahaemolyticus* is the leading cause of seafood gastroenteritis in the U.S. Its cousin, *Vibrio vulnificus*, causes severe septicemia, has a hospitalization rate of 91 percent, and is responsible for 95 percent of U.S. seafood deaths.

In the U.S., *Vibrio* species cause about 41,000 illnesses yearly, increasing during natural disasters involving flooding. Following Hurricane Katrina, 17 cases of *Vibrio vulnificus* were seen – five of them fatal.

Christian Melander, assistant professor of chemistry, and John Cavanagh, professor of molecular and structural biochemistry, are taking a systems biology approach to stopping *Vibrio* infections.

"Our project integrates high-throughput comparative genomics methods, state-of-the-art structural biology, computational studies and drug design strategies," said Melander.

Comparative genomics efforts at the National Oceanic and Atmospheric Administration's Hollings Marine Laboratory will provide information about which gene signal pathways are responsible for *Vibrio* virulence, persistence and adaptability. Cavanagh's structural biology studies will examine those pathways in detail, providing therapeutic targets for Melander's team of chemists to exploit.

The virulence and persistence of *Vibrio* are due to its ability to form biofilms – communities of bacteria that respond differently than a single bacterium to ensure survival in hostile and shifting environments. In the biofilm form, *Vibrio* can be up to 10,000 times more resistant to antibiotics, as well as inherently resistant to the body's immune response.

Melander's research group has discovered a class of chemical compounds that inhibit the formation of biofilm.

"These compounds appear to be effective against not only *Vibrio*, but also several other drug- and immunity-resistant bacteria," said Melander.

Such "superbugs" include: *Haemophilus influenzae* (ear, eye, and respiratory tract infections); *Bordatella pertussis* (whooping cough); *Acinetobacter baumannii* (frequently found in hospitals, infecting patients through open wounds, catheters, and breathing tubes); and *Pseudomonas aeruginosa* (opportunistic infections of immuno-compromised individuals, including cancer and cystic fibrosis patients).

The team has a patent pending on the compounds and their uses and has formed Agile Sciences, Inc. With investor backing, the company will develop the product, recruit drug company partners, and advance products to clinical trials. The eventual products will treat surfaces where target bacteria lurk, including hospitals, medical devices and seafood processing equipment.

This research also has non-medical applications. For example, biofilms enable barnacles to stick to the sides of ships, where they cause drag. Preventing the formation of these biofilms would save the U.S. Navy about $1 billion in fuel costs every year. □

Adapted from Results, *produced by Research and Graduate studies.*

Scope Academy draws big crowd

About 225 alumni, friends, faculty and members of the public registered for Scope Academy, PAMS' weekend of adventure and learning.

Formerly known as the PAMS Alumni & Friends Weekend, the program included a Physics Department barbecue and rededication of Riddick Hall (see related stories, pages 16 and 17), an afternoon series of short classes on intriguing and timely science topics, and the keynote Scope Lecture. Held the weekend of Oct. 12–13, Scope Academy built upon the success of previous weekend events in 2005 and 2006.

"This program is inspired by the fact that people interested in science generally never lose their curiosity and love of learning," said PAMS Dean Dan Solomon. "Scope Academy provides an opportunity to learn something new, and to get a taste of the research being conducted within the College."

The afternoon of Scope Academy featured 10 classes on a variety of topics, from tsunamis and Antarctica to energy and how much "Big Brother" knows about you through data mining. After welcome remarks from Solomon, the "students" eagerly rushed to their classes, which were held in Fox Laboratory.

"You may want to vent the bag so it doesn't pop," said Sharon Schulze, interim director of The Science House, as participants in "Countertop Chemistry" mixed water, baking soda and calcium chloride in zippered plastic bags. The hot reaction filled the bags with gas, inflating them like balloons.

"Vent the bag, Dad," said Katie Osmond, growing concerned. "Dad… Dad!" Her father, Glenn (BS '85 Chemical Engineering), grinned as he held the bag high, waiting for the last possible moment to vent it.

"This was great. I learned so much," said Anne Marie Mazur, who attended with her husband and two children. They had just left John Blondin's astronomy class. "I could have stayed and asked him so many more questions … in fact, here, honey." She handed her bag to her husband. "I'm going to go talk to him," she said as she disappeared into Blondin's classroom.

"It's nice to learn something new and perhaps run into someone you know along the way."

Dale Dusenbury

"Vent the bag, Dad," said Katie Osmond to her father, Glenn (BS '85) as Jack Penny (BS '74, MS '80), left, and Linda Balfour, right, look on.

"It's nice to learn something new and perhaps run into someone you know along the way," said Dale Dusenbury (BS '82 Physics, Science Education), who attended with his 11-year old daughter, Courtney. They attended Ernie Knowles' tsunami class. "I had Dr. Knowles for a class, so it was good to see him again."

Scope Academy not only provides a way for alumni and friends to keep up with the College's research, it also allows the College to provide public science education. The event drew alumni from as far away as Seattle, as well as members of the general public.

"We renamed our weekend of adventure and learning after our magazine, *Scope*," said Solomon. "We hope that Scope Academy gives participants an opportunity to investigate for themselves some of our exciting research and innovations."

Richard Cook, an emeritus member of the PAMS Foundation Board, brought his daughter-in-law, Sharon Freeze and her two teenagers to Scope Academy. They attended a class on North Carolina's water quality and quantity, led by John Fountain and Ryan Boyles. Given the current drought, Freeze found the subject timely.

"It was fascinating," Freeze said. "It was nice to hear about the science and learn about all of the details and other influences that go beyond what reporters tell us."

After the classes, participants gathered in downtown Raleigh at the NC Museum of Natural Sciences for the Scope Lecture. This year's keynote speaker was energy expert Dan Nocera of the Massachusetts Institute of Technology (see related story, this page).

The lecture was followed by a dinner reception and a silent auction. Members of the PAMS Alumni & Friends Advisory Board gathered together an impressive selection of gift items and packages available for bid, including jewelry, NC State athletic ticket packages, a NASCAR Coca-Cola 500 club seat ticket package, and a "Grillin' and Chillin' with the Dean" package for 20.

The silent auction raised about $5,000 toward a scholarship within the College.

"I have enjoyed every event this weekend," said John Pasour (BS '72, PhD '77 Physics), who started the weekend at the Physics Department barbecue. "It was great to see some folks I haven't seen in a very long time." □

Science must address energy issue now

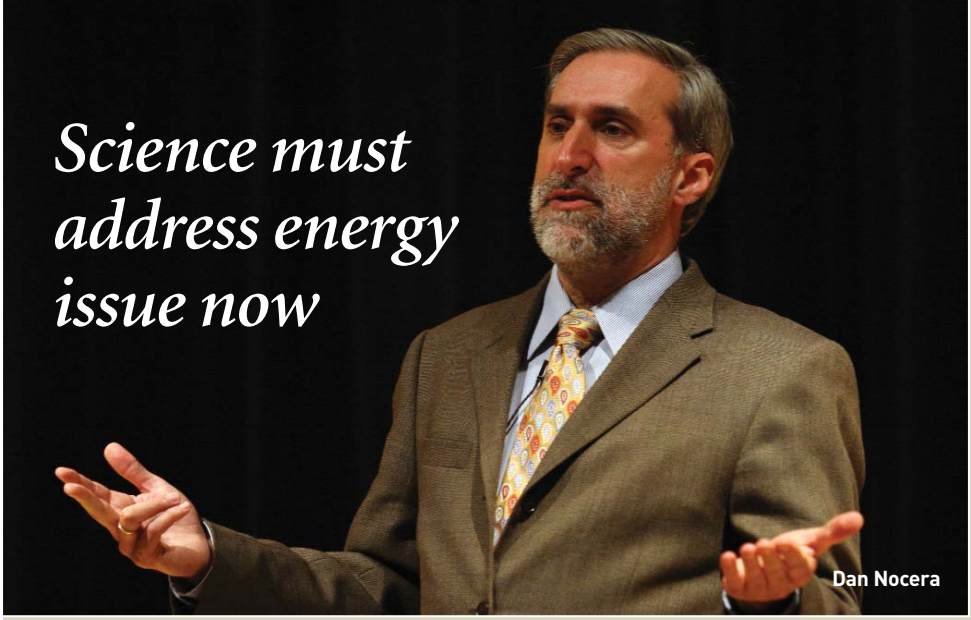


PHOTO BY JOSH LAWSON

Dan Nocera

Today, the world's population uses 12 terawatts of power. In 2050, the total need will be 28 terawatts. To meet this need, scientists must develop solutions within the next 15 years ... because it takes 30 years to implement new technologies.

This sobering statement was one of many made by Dan Nocera, the 2007 Scope Lecturer.

Nocera, the Henry Dreyfus Professor of Energy at MIT, is widely recognized as a leading figure in alternative energy research. He studies the basic mechanisms of energy conversion in biology and chemistry.

Nocera believes that to solve our energy challenges, scientists must look to the sun, which bathes Earth with 100,000 terawatts of power. His lecture, "Powering the Planet: The Challenge for Science in the 21st Century," was a call to action for the scientific community.

"This is a problem for the physical scientists," he said. "There's no escaping it."

He provided a practical examination of the power output possible through traditional sources—nuclear, coal, natural gas and hydro power—as well as new sources such as biomass. It was not encouraging.

Biomass is not the answer. If every plant on Earth were burned, it would produce only about eight terawatts.

Nuclear is not the answer. To meet demand, 3,000 more nuclear plants would be required.

And nuclear fusion?

"It's going to take 35 years to develop an *experiment* with a power output of only a few seconds," he said. "This is too late."

Not that we're running out of fossil fuels. There are hundreds of years of coal, oil and gas available. But consider the damage being done to the world's climate by filling the atmosphere with carbon dioxide. He cited several examples of damage already done by global warming, including the death of half of the arctic's boreal forest and the loss of all three of California's native mussel species.

Then there is the economic impact.

As technologies move away from oil to gas, national economies will rise and fall. Russia holds the largest share of the world's natural gas reserves, positioning it as tomorrow's Saudi Arabia. And because energy is so closely tied to prosperity, which is tied closely to peace, it is in everyone's best interest for all nations to have the power they need.

Nocera feels it imperative that science succeeds. China and India's developing economies will need massive amounts of power. Without a viable alternative, those countries will need to build vast numbers of fossil fuel plants—plants that will pump even more carbon dioxide into the atmosphere.

"The hope is in the science and catalysis that will deliver the sun as a fuel source," he said.

Nocera cited earlier developments of fuel cell technology that successfully achieved viable results. But the materials were expensive.

"We already know how to do it. The challenge is to do it cheaply. We need new materials," he said.

Of course, efforts must be made to support research in this area. Nocera cited a 1912 statement in *Science* recommending the use of technology that mimicked plants' ability to use solar energy. The fact that this has not been achieved in almost 100 years was proof that we don't care enough about the problem, he said. He also made several observations about how politics hinders progress in this area.

"Science will solve this problem," he said, "If allowed to." □

Nocera's appearance was the first university-sponsored, energy-related event after Chancellor James L. Oblinger's announcement of NC State's commitment to a "Year of Energy." The spring 2008 Scope *will focus on PAMS' energy-related research.*

Physics moves into Riddick Hall

It's not easy moving a laboratory-focused department. It takes weeks, trucks of all sizes, multiple moving companies, carts, hand trucks, boxes and a lot of teamwork. Faculty, graduate students and staff all pitched in.

"We only had two weeks to move into Riddick before fall semester started," said Hans Hallen, associate professor and department coordinator of the relocation efforts. "Some facilities were moved after the students came back, but we were up and running in time for classes and laboratory sessions."

Riddick, which housed College of Engineering facilities for many years, was completely gutted in early 2006 after its occupants moved to Centennial Campus. It was a bit surprising to see only its exterior walls left standing. However, soon the new Riddick began to take shape, including a completely new interior floorplan featuring state-of-the-art laboratories, classrooms and lecture halls equipped for modern teaching technologies, offices for faculty, staff and graduate students, and plenty of gathering spaces for students and faculty.

In fact, a highlight of the renovation is a large, two-story, multipurpose room that fills a former "U" space at the back of the building. Architects call this space a "hearth." As new campus facilities are built and old ones renovated, gathering spaces have been incorporated as an important feature of modern education.

"Higher education in the sciences now requires interdisciplinary teamwork and collaboration," said Hallen. "We also have vertically integrated research teams that include students of all levels. So we need more, larger spaces for students and faculty where they can meet to discuss their work."

"Our department has always been close-knit, and one of our traditions is a weekly gathering for students and faculty," said Department Head Michael Paesler. "This room gives us a place to gather for a variety of events, as well as provides students with a large study space. It will function as the activity hub for the building, and our department."

Physics occupies about 80 percent of Riddick. The Department of Animal Science

Riddick's "hearth" bustles with activity all day as it functions as the hub of activity in the building.

occupies the east wing's third and fourth floors.

A somewhat humorous aspect of the floorplan is that the faculty offices once located in Bureau of Mines are now located on a floor above the main auditorium. Because of the auditorium's ceiling height, this office area is not on the same level as the rest of the fourth floor, requiring short staircases and its own elevator stop. It has the same private, tucked away feel that the old location had, prompting members of the construction team to nickname the space, "Bureau of Mines."

According to Steve Reynolds, professor, the faculty and students are trying to avoid using this nickname, since there's already a Bureau of Mines. But the temptation is there, since the space is occupied by exactly the same people.

"Actually, since the elevator identifies our stop as 'U-4' for upper-fourth floor, some people are calling it 'U-Fouria,'" Reynolds said.

Euphoria may aptly describe the feelings of faculty, staff and students who now enjoy working and studying in Riddick. Physics gained about 10,000 additional square feet in the move – space necessary for the department's continued growth.

Everyone also seems to appreciate the natural light provided by Riddick's plentiful windows.

Perhaps the greatest advantage of the move is that so much of the department is now under one roof.

"I had three labs in three different buildings, so consolidating labs has been great," said Laura Clarke, assistant professor. "It's nice having my office near my lab, instead of five floors away."

In 2000, North Carolina's voters approved a $3.1 billion bond referendum to allow the UNC system to build new facilities and renovate old ones to accommodate projected increases in the student population and changing needs. NC State's portion of the funds was just under $500 million. The Riddick renovation is part of this initiative.

In addition to Riddick Hall, Physics has space in Partners III on Centennial Campus. This building houses faculty and laboratories focused on nanotechnology research. A few faculty and staff will maintain offices and some laboratories in Cox, Dabney and Fox, as well as Research Building II, also on Centennial Campus.

"For a department that was once housed in 11 buildings, it's a joy to be down to only six," said Paesler. "We are quite pleased with the feel of our facilities in Riddick. We are finding a new sense of departmental community that only a large central facility such as this can provide. We are genuinely indebted to all those citizens who voted for the bond referendum that made the renovation of Riddick possible."

Space in Cox and Bureau of Mines formerly occupied by Physics will have new PAMS tenants, including the Center for Research in Scientific Computation, the Center for Quantitative Sciences in Biomedicine, and support services such as PAMS Computing and Business offices. □

PHOTOS BY SALLY RAMEY

Two graduate students conduct research in a laboratory belonging to Keith Weninger, assistant professor, whose specialty is biophysics and soft-condensed matter.

In Assistant Professor Laura Clarke's laboratory, graduate student Mary Scott connects cables to monitor the temperature of a sample in a high-vacuum chamber.

"We are quite pleased with the feel of our facilities in Riddick. We are finding a new sense of departmental community that only a large central facility such as this can provide."

Michael Paesler

A new building and barbecue for Physics

Faculty, alumni gather to celebrate history and new beginnings

A new building is a good excuse for a party, or so thought Michael Paesler, head of the Physics Department.

"How often do you get a new building?" he said. "We thought this year was the perfect time to invite alumni back to campus. We know they share in our excitement about having new facilities, and they'll be curious about how it's set up. And we're just as excited and curious about what's been going on in their lives."

Physics recently hosted alumni, students, faculty and friends at a barbecue and rededication ceremony celebrating the department's move into a totally renovated Riddick Hall (see related story, page 14).

"Our department has a lot to be proud of," said Michael Paesler, department head. "We've experienced more growth than many others across the nation, and we're very pleased with the strength and scope of our programs. But Riddick represents a new era for us, and it deserves a celebration."

PHOTO BY SALLY RAMEY

PHOTO BY BRADLEY WILSON

"One of our department's traditions is a weekly afternoon tea in conjunction with our colloquiums. Since moving to Riddick, we've given out three times the cookies at our teas!"

Michael Paesler

About 65 faculty, students and alumni attended a barbecue hosted at Paesler's home on Friday, Oct. 12. As one of the first reunion-style events hosted by the department, the event drew alumni of all ages from across the U.S.

"It was great to see some of my old professors," said Robert Jackson (BS '75.)

The first thing Tim DelSole (BS '88) asked was, "Is Dr. Tilley here?" He was.

Larry James (PhD '89) and Gerd Pfeiffer (PhD '91) catch up at the Physics Department barbecue.

"I know you!" said Jack Penny (BS '74, MS '80) as he greeted his old classmate Gary Denton (BS '74) for the first time in years.

The group enjoyed a classic North Carolina meal with a twist–the usual fried chicken, pork barbecue, hush puppies and banana pudding were accompanied by vegetarian selections provided by Brand Fortner, research professor, and his wife, Susan Andresen. Attendees laughed and talked for hours.

The next morning, about 125 people gathered at Riddick Hall for the rededication

Tour participants look at a demonstration regarding the movement of granular materials in Assistant Professor Karen Daniel's laboratory.

ceremony. PAMS Dean Dan Solomon presided over the event, which featured comments from Paesler, Professor Emeritus Jasper Memory, and Vice Chancellor for Research and Graduate Studies John Gilligan.

Paesler thanked university architects and facilities personnel, contractors, and faculty and staff who had worked as part of the university's design, construction and relocation teams. He noted that not only was Riddick designed to provide outstanding facilities for learning, but to encourage collaboration.

"The hearth is filled with students studying, working on projects in groups and talking with faculty. Riddick gives us a better sense of community," said Paesler. "I'll give you an example – one of our department's traditions is a weekly afternoon tea in conjunction with our colloquiums. Since moving to Riddick, we've given out three times the cookies at our teas!"

Paesler announced that the department head's conference room has been named for Professor Dick Patty. During the ceremony, the auditorium was named for Dale Sayers (see related stories, this page). Sayers' wife, Anne, unveiled a plaque that will be mounted just outside the auditorium's doors.

Attendees also received a summary of the department history, compiled by Ray Fornes, associate dean for research, and Memory. The full history will be made available to alumni through the department's Web site. Memory shared highlights of the history with the audience.

Gilligan then rededicated Riddick Hall, "as a gateway through which our students will enter the world of scientific discovery, in recognition of the faculty, staff and friends who have worked to make this project a reality, and in gratitude to the citizens of North Carolina, who voted in 2000 for the higher education bonds that made this project possible."

He concluded with, "Dan, Michael, faculty and students – congratulations, and if success can be measured in cookies, I'm sure you'll be giving out cookies for many years to come."

Following the ceremony, participants toured the building, including selected laboratories where they learned about current research projects. The tour ended with a social in the hearth.

The events were held in conjunction with Scope Academy (see related story, page 12). □

Sayers Auditorium dedicated

Riddick Hall's main auditorium has been named in memory of Dale Sayers.

Sayers, a member of the Physics Department faculty, died unexpectedly in 2004.

He was a pioneer in EXAFS – extended x-ray absorption fine structure – a key analytical tool now used by scientists around the world. His work opened a new field of research using this technology. He also was affiliated with a team that discovered a new x-ray technique, called diffraction-enhanced imaging, which is emerging as a new tool for mammography, osteoarthritis investigations and bone density studies.

Sayers has been memorialized by colleagues around the world. The International XAFS Society now presents the Dale Sayers Young Scientist Award every three years. Family and friends established the Dale E. Sayers Memorial Fund, which will support a graduate student fellowship at NC State. The Physics Department also named a lecture series in his honor.

"Dale's colleagues, students and friends have made a commitment to complete the endowment of the fund, which enabled us to name this facility," said Anita Stallings, executive director of Development and College Relations.

"This auditorium will be a focal point for our most significant lectures and events," said Michael Paesler, department head. "Dale was a devoted educator who was committed to his students. It seemed only fitting that our department's premier educational space should honor one of our brightest stars."

For information about supporting the Sayers Memorial Fund, see "How to make a gift" on the inside back cover. □

PHOTO BY JOSH LAWSON

Department Head Michael Paesler and Anne Sayers

Conference room honors Patty

The Physics Department has named the department head's conference room to honor Dick Patty, who served as department head from 1975 to 1995.

During this period, the department grew significantly and earned national prominence. External support for research increased tenfold, and strong faculty members were added in many areas, including astrophysics, condensed matter physics, and research in physics education.

Patty's tenure was second only to that of Charles M. Heck, the head from 1917 until 1945.

The Richard R. Patty Conference Room is adjacent to the department head's office, on the fourth floor of Riddick Hall. The honor was announced during the Oct. 13 rededication of Riddick Hall. □

Scientists create genetic light switches

Researchers at NC State have developed a way to switch genes off and on using ultraviolet light. The work has implications for many areas of genetic research.

Alex Deiters and Jeff Yoder with tanks of zebrafish in the College of Veterinary Medicine's research facility

The project's lead researchers are Alex Deiters, assistant professor in the Department of Chemistry, and Jeff Yoder, assistant professor of molecular and biomedical sciences in the College of Veterinary Medicine. They have received a five-year, $1.4 million grant from the National Institutes of Health (NIH) to develop a series of "photo-switchable" compounds that will allow scientists to turn individual genes on and off within zebrafish embryos, enabling them to determine functions of particular genes.

Zebrafish have long been used for studying gene functions during embryonic development, partly due to how their embryos' transparency makes observation easier. The recent sequencing of human and zebrafish genomes and identification of more than 30,000 genes have increased the zebrafish's importance as a model organism in resolving individual gene functions.

"Traditionally, scientists have tried to figure out a gene's function by either over-expressing or genetically disrupting a particular gene and looking at what happens to the embryo as a result," Yoder said. "Does the embryo's heart or circulatory function change? Does it mimic a disease?"

The problem with this approach is that it lacks a mechanism for "spatio-temporal" control of the gene's expression. In living animals, genes are activated at particular times within an organism, and then switched off after they serve their purpose.

"To determine what the genes do, you must mimic nature's precision in turning genes on and off," Deiters said.

To address this problem, Deiters and Yoder developed a novel solution – the construction of photo-sensitive organic compounds that can bind to a specific RNA molecule and are responsible for "telling" an expressed gene when to switch off and on. These artificial gene switches are then introduced into zebrafish embryos and exposed to ultraviolet light, creating a literal "light switch" for genes.

Deiters and Yoder hope to create an entire array of these photo-sensitive compounds that are tailored to different types of RNA, in effect providing a suite of tools for the spatio-temporal control of gene expression in zebrafish.

"One of the major advantages of this approach is that it allows scientists to switch off a gene that has previously been activated, which is not currently possible," Deiters said. "In addition, scientists can direct the light to individual cells, and that will enable them to see exactly what the gene in question is doing within the organism." □

PHOTO BY ROGER WINSTEAD

Chemistry Department gains two new professorships

A gift to the UNC system, and a unique double-match incentive, have resulted in two new professorships in the Chemistry Department.

The C. D. Spangler Foundation has endowed one professorship on each of the 16 campuses within the University of North Carolina system. The foundation will invest up to $20 million over five years to help each campus qualify for another professorship each year – potentially adding 80 more professorships.

A successful Charlotte businessman and passionate advocate for public education at all levels, C. D. Spangler, Jr. served as UNC System president from 1986 to 1997. Previously, he and his family foundation had endowed or completed 37 professorships across the system.

"Good professors are professors who like teaching students and like doing research. This effort on the part of my family is intended to retain, reward and recruit good professors," Spangler said.

NC State's administration placed its professorship in the Chemistry Department. The Spangler Foundation named it the Governor Robert W. Scott Distinguished Professorship.

The foundation's private contribution has received matching funds from a state program designed to encourage such investments. As reported in previous issues of *Scope*, the NC State Legislature provides funds to the Distinguished Professors Endowment Trust Fund to match endowed professorship gifts on a 1:2 basis. This reduces the donor contribution for a $1 million professorship to $666,000.

Last year, the PAMS Campaign Committee allocated $2 million for additional matches, further reducing a donor's professorship contribution to $333,000.

Lord Corporation of Cary established a chemistry professorship under this program. A global developer and manufacturer of products and technologies that provide adhesion and bonding, control motion and minimize the effects of shock and vibration, the company has had a close relationship with the university for more than 20 years.

Dick Ambrose, Lord's vice president for research and technology, served on the PAMS Foundation Board, and guided the company's involvement with NC State. This included partnering with the Center for Research in Scientific Computation (CRSC) and the Department of Mathematics on numerous research projects, which provided outstanding opportunities for faculty and students, as well as benefits for the company. In 1999, the company established The Lord Corporation/CRSC Graduate Fellowship.

Before Ambrose's recent retirement, he arranged a campus visit for a team of Lord executives, including Lord president and CEO Rick McNeel. The group toured PAMS facilities and met with faculty. During the visit, PAMS staff explained the matching opportunity, which intrigued the Lord team.

The result is the Lord Corporation Distinguished Professorship in Chemistry.

"We recognize the value of strengthening the capabilities of potential employees attending local universities," said Miriam Zietlow, director, chemical products development with Lord. "One way to do this is to strengthen the health and well-being of a university's academic department and improve the learning environment through professorships."

"Named professorships are an increasingly important tool for recruiting and retaining outstanding faculty who are both great teachers and great researchers," said Dan Solomon, dean. We're grateful for Lord's previously established fellowship in our applied mathematics program, and excited to begin a closer relationship through this chemistry professorship." □

Statistics alumni close to professorship goal

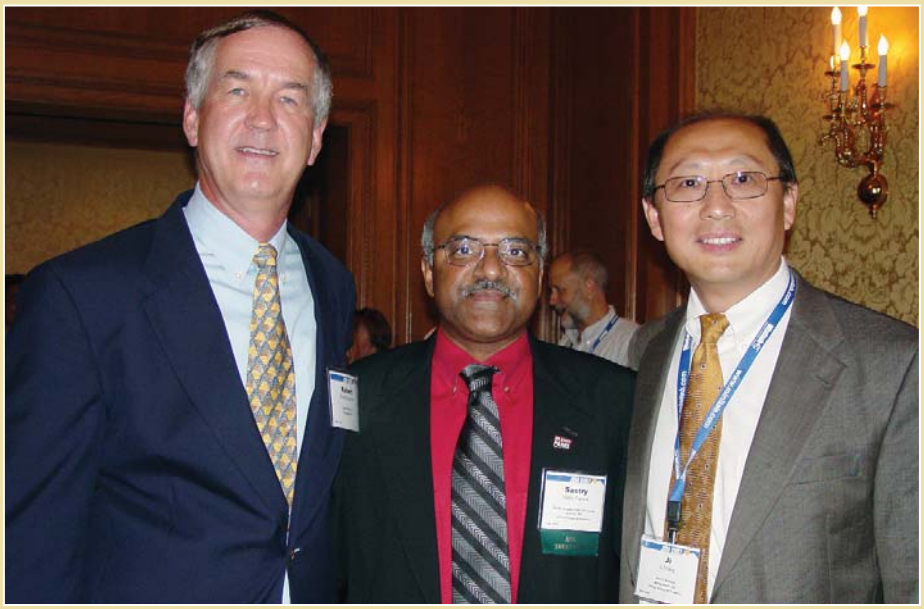


PHOTO BY ANITA STALLINGS

Bob Starbuck, Department Head Sastry Pantula and Ji Zhang at the 2007 Joint Statistical Meetings

Several statistics alumni are working to secure contributions from alumni, faculty and friends to establish the R. A. Fisher Distinguished Professorship for the Statistics Department. The group is led by Ji Zhang, the 2007 recipient of the PAMS Medal of Achievement, and Bob Starbuck, a former member of the PAMS Foundation board.

"When the Statistics alumni reach their goal, it will leave one remaining opportunity to establish a $1 million professorship for $333,000 under our double match," said Anita Stallings, executive director of Development and College Relations for PAMS. "With 85 percent of their goal collected, they are getting very close." (This double-match program is described in the story at left.)

Professorships are crucial for attracting and retaining outstanding faculty who in turn attract top students and motivate the next generation of scientists, scholars and policy makers.

Anyone interested in contributing to the statistics professorship fund may follow the instructions for making a gift, located on the inside back cover, or contact Stallings at astallin@ncsu.edu for more information. □

Astrophysicists receive grant to study supernovae mysteries

NC State astrophysicists John Blondin, Kazimierz Borkowski, and Stephen Reynolds have received a $585,900 grant from the National Science Foundation (NSF) for theoretical investigations into the nature of one of the two types of supernovae explosions.

These researchers' findings have far-reaching impacts across astrophysics.

Type Ia supernovae are thought to occur when a white dwarf star, the extremely dense remains of a low-mass star, happens to have a companion star close enough to drop material onto the white dwarf, raising its mass over a critical limit. The white dwarf then detonates like a gigantic thermonuclear bomb. About one-fifth of all supernovae are of this type, the rest involving single massive progenitor stars that run out of fuel.

Since all Ia supernovae result from white dwarfs just barely over the critical mass, these explosions are also quite similar to one another, so much so that they are regularly used as standards to measure distances to the galaxies in which they occur. They are also extremely bright, so they can be seen at enormous distances, and have been used to chart the expansion of the universe and the recently discovered surprising acceleration of the expansion.

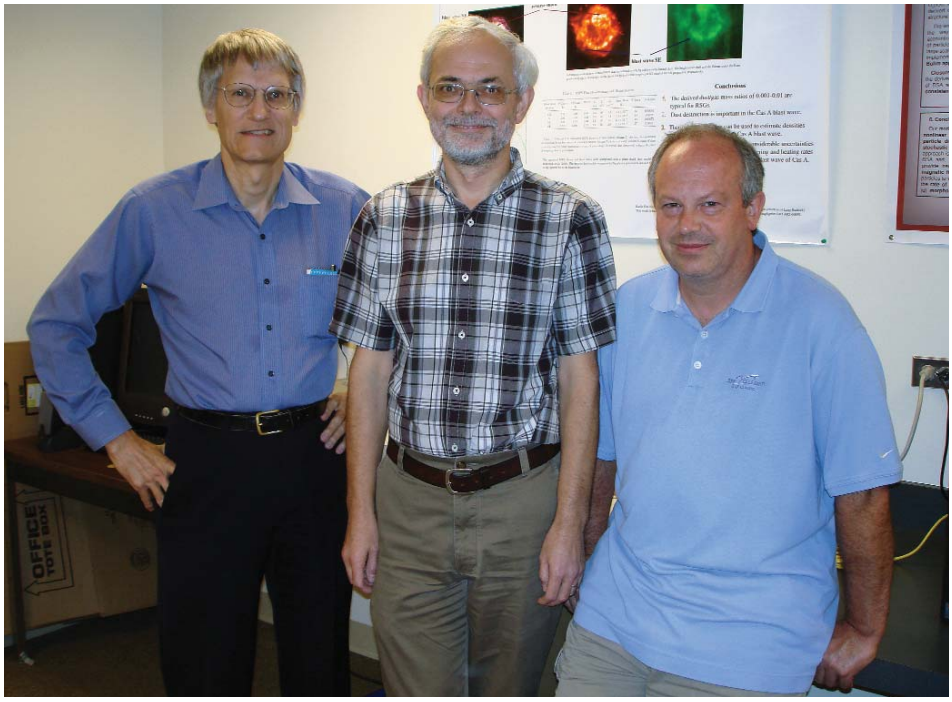


PHOTO BY SALLEY RAMEY

Stephen Reynolds, Kazimierz Borkowski and John Blondin

Type Ia supernovae also produce many of the universe's heaviest elements, including most of its iron.

But recent discoveries by these researchers have shown that not all Type Ia supernovae are so similar after all, raising critical questions about using them as the basis for distance measurement. Therefore, their findings, reported in the last two issues of *Scope,* have far-reaching impacts across astrophysics.

Blondin, Borkowski and Reynolds have collaborated for 15 years on investigations into supernovae remnants, their work primarily funded by NASA. □

How thirsty is your grass?

It hasn't rained in days and you need to water your lawn. But there are water restrictions in place because of the drought, and you want to be a responsible citizen.

So what do you do?

"A lot of people water too much, too often," said Ryan Boyles, state climatologist and director of the State Climate Office (SCO), based at NC State. "So we've developed a system to help them give their lawns what they need, when they need it."

The SCO and the Department of Crop Science have a Web-based service called the Turf Irrigation Management System (TIMS).

The TIMS service is available at no cost to North Carolina residents, from homeowners to turf professionals.

Located at www.TurfFiles.ncsu.edu/TIMS, the program guides lawn owners through a series of questions about the type of grass, soil and irrigation system they use.

Lawn owners are then told to place containers around the lawn to measure the amount of water their system puts out over timed intervals.

Once this data is entered, TIMS calculates the irrigation amount the grass really needs.

How does TIMS know?

Based on the lawn owner's address, climate information is retrieved from the closest weather station, which is part of the NC Climate Retrieval and Observations Network of the Southeast (CRONOS).

TIMS calculates the irrigation needed by the lawn owner's specific turf, based on the soil type and recent weather conditions, including precipitation and evaporation.

"Water conservation is everyone's responsibility, especially in light of North Carolina's drought situation," said Boyles. "TIMS will help NC residents water more effectively, and reduce waste of a valuable resource." □

So how much rain did you get at your place?

North Carolina weather buffs can now play an active role in meteorological reporting and research using inexpensive equipment in their backyards.

NC State and the National Weather Service are looking for volunteer weather observers across the state to collect precipitation data for the Community Collaborative Rain, Hail and Snow Network (CoCoRaHS).

North Carolina is the 21st state to introduce the CoCoRaHS program, which was started in 1998 and is based at Colorado State University. This unique, non-profit network of volunteer weather observers measures and reports rain, hail and snow amounts to provide the maximum amount of data for natural resource education and research.

"North Carolina has the most complex climate in the eastern U.S.," said Ryan Boyles, state climatologist and director of the State Climate Office (SCO), based at NC State. "Data gathered from CoCoRaHS volunteers can be very important in better understanding our climate."

According to Boyles, average annual precipitation ranges across the state from less than 40 inches in some areas to more than 90 inches in parts of western North Carolina. In some years, some monitoring stations report even less than 30 inches of precipitation, while in other years, some stations report more than 120 inches.

"The statewide record for 24-hour rainfall total is 22.22 inches from July 15–16, 1916, in western North Carolina," he said. "That stood as the nationwide record for many decades."

Observations reported by CoCoRaHS volunteers will be used by a wide range of agencies and scientists, including National Weather Service and UNC system scientists, to monitor and study rainfall patterns, drought, and the impacts to our surface water systems.

Darin Figurskey of the National Weather Service's Raleigh Forecast Office, stressed the potential value of observations from CoCoRaHS observers for local monitoring.

"Summer thunderstorms can dump more than three inches of rain in some areas, while areas just a few miles away get little or no rainfall," Figurskey said.

CoCoRaHS volunteers must use a standard scientific rain gauge, available through CoCoRaHS for about $30, including shipping. Volunteers install the rain gauge on their property about five feet above the ground in a site with little or no obstruction from trees or other objects.

"North Carolina has the most complex climate in the eastern U.S. Data gathered from CoCoRaHS volunteers can be very important in better understanding our climate."

Ryan Boyles

PHOTO BY SALLY RAMEY

Gauges may be installed on a fence post, deck or other location with no overhead obstruction.

Volunteers also complete a short online training program available through the CoCoRaHS Web site so they know how to properly measure precipitation. They should be willing to enter precipitation data between 6 a.m. and 9 a.m. daily through the CoCoRaHS Web site.

"This is a great activity for science teachers and their students, for the farmer who tracks precipitation, or for weather hobbyists who want to contribute to our knowledge of the environment," Boyles said. "This program will help meteorologists, researchers, the media and others see and study the variability of precipitation across North Carolina."

To learn more and order a rain gauge, visit the SCO Web site at www.nc-climate.ncsu.edu/ or the CoCoRaHS Web site at www.cocorahs.org. Once you register and begin to report, your rainfall observations will become part of the volunteer record, and will be plotted on maps of your county and state. You can view the maps and see how your observation fits in with your neighbors involved in CoCoRaHS across the country. □

Why we give

Reasons donors support PAMS are as unique and varied as the donors themselves.

Charles Welby was a professor in the Department of Marine, Earth and Atmospheric Sciences for 25 years before he retired in 1992. Through a number of funds and endowments, he has supported geology students. In 1996, he established the Charles and Eleanor Welby Geology Scholarship endowment.

"Eleanor and I were raised with a sense of altruism, and the idea that you should contribute where you can to better society and life in general," Welby said.

While this sentiment is shared by others who provide financial support for PAMS, some have additional reasons. But whatever the reason, their support is important. Scholarships, fellowships, professorships and other endowments, coupled with in-kind and other gifts, play a vital role in enabling PAMS students, faculty and programs to achieve their best.

"We have students who cannot afford college without scholarships," said Anita Stallings, executive director of Development and College Relations. "We have programs like The Science House that need resources to enable them to succeed. We require professorships to attract the best faculty to teach our students. PAMS is an outstanding college, in part, because of our donors' support and generosity."

While all gifts are appreciated, endowment provides a permanent, stable source of income. Endowment is PAMS' primary focus in the remaining months of the Achieve! Campaign for NC State. Many donors are involved in helping PAMS meet a crucial campaign objective to more than double its endowment.

"We must train many more scientists, and make the physical sciences more attractive to students," said Jim Witherington (BS '72 Mathematics), who established the James N. Witherington Scholarship Endowment. He was inspired by his father, who sponsored a university Caldwell Scholarship.

Nancy Ridenhour (BS '76 Statistics), a former member of the PAMS Foundation board of directors, is a member of NC State's Lifetime Giving Society. In addition to supporting various PAMS funds and initiatives, she made a significant contribution toward replacing old, unsightly furnishings in the first floor lobby between Cox and Dabney halls. She enlisted the help of fellow alumni Marvin and Mary Chaney, and today, the furnishings in the Ridenhour-Chaney Lobby are constantly used by students studying and working together.

"Even though my father paid my education costs, I realize that it took a lot of people giving through various means to make my education possible," said Ridenhour. "Since the one thing no one can take away from you is your education, I give to allow others to obtain their education."

An active advocate of the College, Ridenhour also encourages other alumni to become more familiar with PAMS.

"Since the one thing no one can take away from you is your education, I give to allow others to obtain their education."

Nancy Ridenhour

PHOTO BY PAUL HUBBARD

Darren Holman, Amy Rhodes, Tom Rhodes, Chris Rhodes and Claire Rhodes celebrated an endowment signing in the College box at an NC State football game.

"Nancy was responsible for getting me involved," said Tom Rhodes, (BS '65 Applied Mathematics). He had a long-time history of making contributions to the College, but he became intrigued after attending the PAMS Realizing Possibilities Dinner, where he heard students make speeches about what their scholarships meant to them.

"I was hooked by the relationship I witnessed between the faculty and students, and the quality and potential I saw in the students," he said. "I was also impressed by the quality of the faculty, how much they really care about students, and the value of their research."

Rhodes became another advocate for PAMS, helping to connect it with other potential partners in the Charlotte area. He serves on the PAMS Foundation board of directors, and in 2006, he established the Thomas and Bonnie Rhodes Scholarship Endowment.

Sherice Nivens (BS '98 Chemistry) said that she sees it as her mission to give back to PAMS because of the way it supports its students.

"NC State has proven to be a tremendous resource in helping me to achieve my educational goals," she said. "PAMS especially opened many doors of opportunity in my professional career that allowed me to be far more successful than I ever dreamed."

Robert Starbuck (MS '72, PhD '75 Statistics) has been very connected with NC State ever since he graduated. Through the years, he supported the Fund for Excellence and The Science House. Along with fellow statistics alumnus, Ji Zhang (PhD '90), he leads an alumni effort to fund the R. A. Fisher Professorship in Statistics (see related story, page 19).

"The Fund for Excellence gives the dean of PAMS the needed flexibility to achieve programmatic objectives that otherwise might not be possible to attain," Starbuck said.

While serving on the PAMS Foundation board of directors, he learned about The Science House, the College's K–12 science and mathematics education outreach program.

"This marvelous program helps many K–12 students better understand and appreciate science, and undoubtedly has a positive impact on the number of students choosing a science-based career," he said.

"The R. A. Fisher Professorship in Statistics will create a prestigious professorship in the Department of Statistics, help the department to attract and retain top talent, and give visible recognition to the department and to deserving professors," Starbuck said.

Donors also share a sense of pride in the College, an enjoyment of their connections to it, and an appreciation for how their support will continue giving well into the future.

"PAMS has the feel of a small private college with the resources of a major state university," said Rhodes. "I'm glad to have an opportunity to give back a little to NC State. It's fun, and I enjoy being involved."

"Supporting education is one way to demonstrate how you value education. It's also a way to say "thanks" to the educational institutions, departments and faculty that contributed to your education," said Starbuck. "In addition to the immediate satisfaction of giving, one can take pleasure in knowing that a gift will provide lasting benefits to all those affected by the gift."

Anyone interested in making a gift as part of the Achieve! Campaign for NC State will find information on the inside back cover of this issue of Scope. *The campaign ends June 30, 2008.* □

Why I give

Education is important at all levels. It benefits everyone. The more educated a society, the greater the people's standard of living, the less likely they'll be in war, and the more civilized the society in general.

I've always felt that education is important. It is hard to find a better way to spend one's money than to educate yourself, your own family, or someone else through direct contributions. Everyone benefits in the long run.

Science is my background so there was a natural attraction to PAMS at NC State. I think anyone educated in science has a natural appreciation for the importance of science and how it can help raise the standard of living of society.

I also had an interest in PAMS when I was working for Lord Corporation in its technology group. We needed a source of good scientists we could hire to support our growing company and replace those who retired. PAMS has provided that source for years. This relationship needs to be a two-way street. Lord Corporation used NC State analytical facilities and professor consultations, and hired NC State students. In return, Lord made regular contributions to PAMS and NC State during those years, and continues to do so today.

On a personal level, my wife, Marsha, and I contribute to both PAMS and The Science House. The Science House is trying to encourage math and science at the K–12 levels. Our primary and secondary educational systems are lagging behind our university educational system. The Science House is an opportunity to change that.

My own contributions to PAMS have been directed toward the Fund for Excellence. These are monies used to recruit top notch students and professors. More importantly, these monies are hard to come by because organizations like the National Science Foundation and National Institutes of Health won't provide funding for such things. University departments are pretty much on their own in finding funds for many important activities. I welcomed the opportunity to help the Fund for Excellence and the important role it plays in supporting the University.

Dick Ambrose

While not an alumnus, Dick Ambrose has been a long-time friend of the College and has served on the PAMS Foundation board of directors. He was instrumental in developing the mutually beneficial research partnerships between NC State and Lord Corporation. For information about his contribution to The Science House, see the related story, page 24.

Science House matching program attracts two endowments

A 1:2 matching program provided by an anonymous donor has led to the establishment of two more endowments to support The Science House, the College's K–12 science and mathematics outreach program.

Lenwood Dennis (BS '66 Experimental Statistics) has established the Lenwood and Carolyn Dennis Endowment for The Science House. He and his wife, Carolyn, participated in a signing ceremony in the College's skybox in Vaughn Towers at Carter-Finley Stadium during a 2007 football game.

"He values any opportunity to fund initiatives in science education programs," said Denise Hubbard, director of development, who organized the signing ceremony. "Lenwood believes that for the U.S. to remain competitive, we must increase our numbers of students pursuing careers in science and technology."

Another signing ceremony was held at The Science House.

PHOTO BY SALLY RAMEY

Marsha Ambrose visits with Algebra Camp students after the endowment signing ceremony.

To honor his wife's interest in science education, Dick Ambrose established an endowment in her name that will support The Science House. He is a long-time friend of the College and former member of the PAMS Foundation board of directors.

The Ambroses came to campus for a signing ceremony establishing the Marsha Ambrose Endowment for The Science House. Interim Director Sharon Schulze led them on a tour of The Science House, and then into a laboratory full of students attending Algebra Camp.

The Ambroses were surprised when Dean Dan Solomon announced to the class that they were to be the first students to ever witness an endowment signing ceremony. The students listened intently as Solomon explained the Ambroses' gift and what it meant to them. After the ceremony, Marsha visited with the students at their lab tables, where they were working on group projects. Some gave her hugs of congratulations and appreciation.

"It meant so much to me that the kids were here," she said. "That made it very special." □

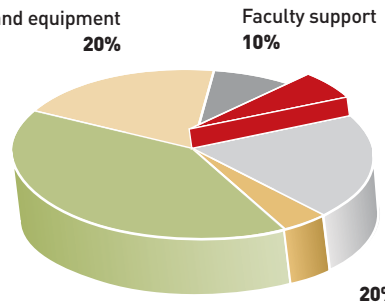
PHOTO BY ROGER WINSTEAD

Alumni honor graduate professor

Norman Banks (MS '62 Physics), G. Lansing Blackshaw (PhD '66 Nuclear Engineering), Thomas Hirons (PhD '66 Nuclear Engineering) and Wilson "Bill" Leggett (PhD '62 Nuclear Engineering) were students when the nuclear engineering program was moved from the Physics Department to the then School of Engineering. The group recently honored Wes Doggett, who had been their graduate professor, by contributing to the Wesley O. Doggett Endowment for The Science House.

The group gathered at NC State one day this summer to celebrate their gift. Shown are (front row) Molly Blackshaw, Carolyn Banks, Leonor Doggett, Suzanne Leggett, (back row) Lansing Blackshaw, Norman Banks, Wes Doggett, Thomas Hirons and Bill Leggett.

Achieve! The Campaign for NC State



6% **The Science House/K–12 outreach**
Increasing endowment resources to support K–12 outreach is an important objective of NC State's $1 billion campaign. The article on page 24 highlights recent gifts. At this time, PAMS is at 73 percent of this goal. A matching program is available for eligible gifts.

PAMS Campaign Goals	Endowment	Current Needs
Undergraduate and graduate student support $10 million will double the current level of support, providing resources to compete for talented students and meet financial needs	$ 6,500,000	$ 3,500,000
Faculty support $5 million will endow professorships to recruit and retain distinguished teaching and research faculty	5,000,000	
The Science House/K–12 outreach $3 million will create an endowment to provide permanent support for The Science House, and fund current teacher training and student science programs	1,000,000	2,000,000
Facilities and equipment $10 million will support modern instructional methods and technologies		10,000,000
Unrestricted support $2 million in flexible, current gifts will allow us to respond to exciting opportunities, urgent needs and unexpected challenges		2,000,000
Research and program development $20 million will enable us to conduct research and develop academic programs leading to discoveries and knowledge that enhance quality of life and stimulate economic development		20,000,000
Total	$12,500,000	$37,500,000

PAMS Campaign Needs **$50,000,000**

How to make a gift

You may remember how difficult it was to manage the expense of higher education. You may want to help today's students achieve their dreams.

The PAMS Foundation provides many ways to support students, faculty and programs of the College. Whether you want to contribute to an existing scholarship, support a departmental enhancement fund, make a memorial gift or consider support in other areas, our staff is available to help you explore the options.

To support existing funds

To contribute to a scholarship, fellowship or other fund, fill out our secure, online gift form at https://www3.acs.ncsu.edu/pams/ or mail a check to the PAMS Foundation, Campus Box 8201, Raleigh, NC, 27695. Make checks payable to PAMS Foundation and write the name of the fund on the "notes" or "for" line.

If your employer provides matches for charitable donations, please send a completed matching gift form with your contribution.

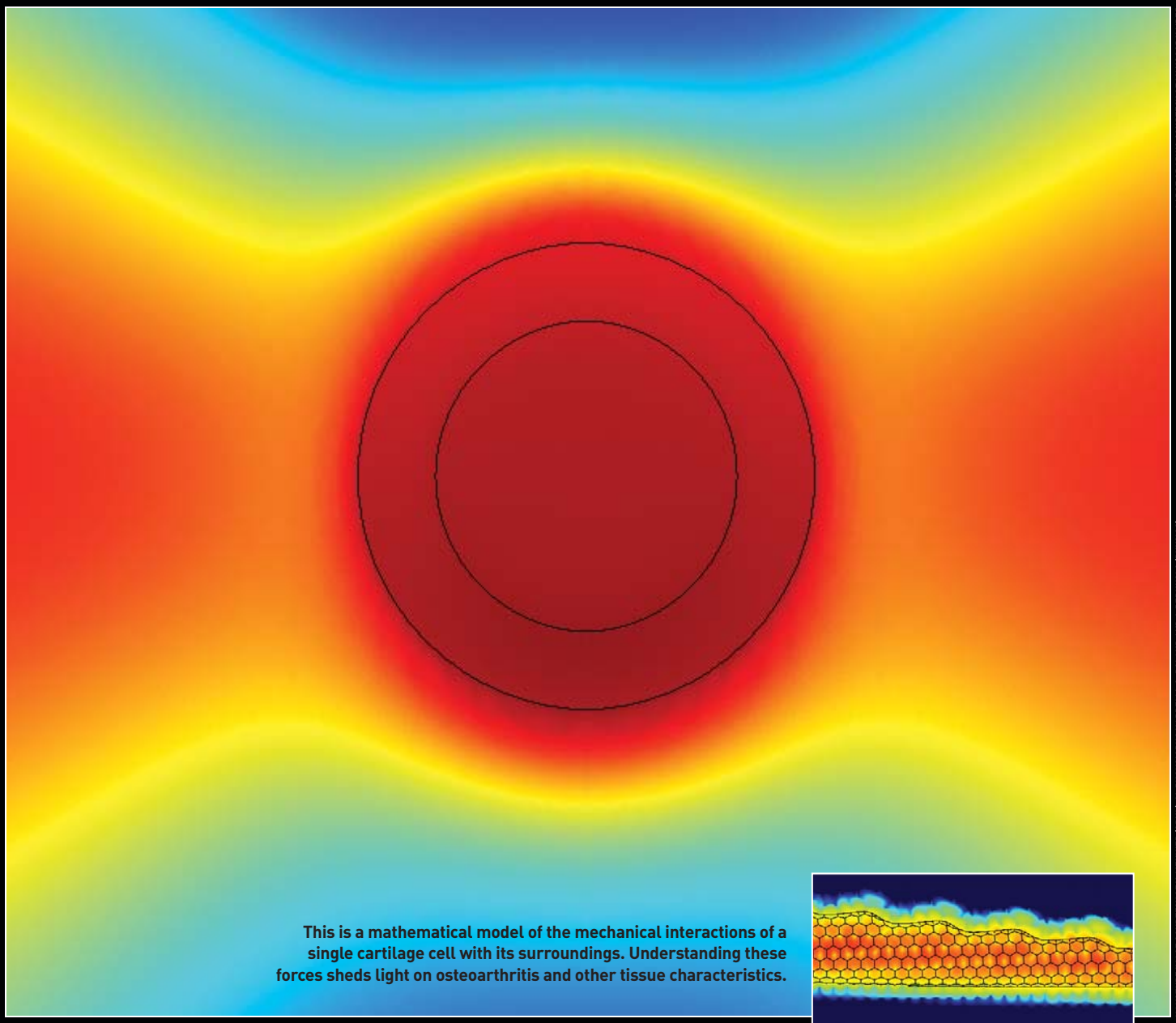
There are many funds not mentioned in this issue of *Scope*, and several have specific designated uses. If you would like information on our various funds to help you decide the best fit for your support, please call us at 919-515-3462. For a list of funds, visit www.pams.ncsu.edu/development/funds.php.

To explore other options

If you have questions about gift planning, we can help you identify tax benefits, choose between permanent endowment versus one-time support, and explore estate planning or life-income options.

There are many ways to match your interests with specific College needs, and several possibilities for making your vision a reality. Whether using cash, appreciated stock, real estate or a bequest, we can help you find the best way to make the most of your gift.

Contact us at 919-515-3462 or by e-mail at pamsalumni@lists.ncsu.edu. □



LARGE GRAPHIC COURTESY OF MANSOOR HAIDER

This is a mathematical model of the mechanical interactions of a single cartilage cell with its surroundings. Understanding these forces sheds light on osteoarthritis and other tissue characteristics.

NANOTUBE IMAGE COURTESY OF V. MEUNIER (ORNL), M. BUONGIORNO NARDELLI, C. ROLAND AND J. BERNHOLC (PHYSICS)

Carbon nanotubes promise to play a key role in emerging technologies.

Mathematics improves understanding of materials

The development, analysis, simulation and control of materials for emerging applications involves all of the physical sciences and plays an increasing role in biological and biomedical sciences as well as nanotechnology. Mathematical analysis is important in developing new materials, improving performance of existing materials, and providing frameworks that bridge scientific disciplines.

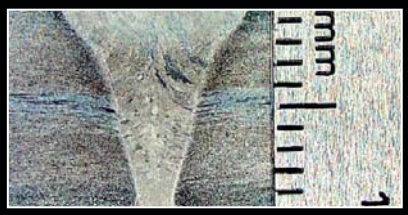
A Mathematics Department team led by Ralph Smith, Pierre Gremaud, Mansoor Haider, Negash Medhin and Michael Shearer is developing Research Training Group activities for undergraduates, graduate students and postdocs through a five-year National Science Foundation initiative. These activities focus on five topics critical to emerging technologies:

- Multifunctional materials
- Polymers and composites including carbon nanotubes
- Orthopaedic biomaterials
- Dynamics of thin material layers
- Material behavior of laser welding

The program will attract and train highly qualified students and postdocs for careers at the interface between applied mathematics and materials science, engineering, physics and advanced technology. □

COURTESY OF KAREN DANIELS (PHYSICS)

Understanding granular flow improves industrial processes.



COURTESY OF JAY TU (MAE)

Modeling characterizes effects of laser-based manufacturing techniques on metals.